A HISTORY OF THE IRON AND STEEL IN CENTRAL EUROPE BETWEEN THE ROMAN EMPIRE AND MIDDLE AGE

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https://doi.org/10.37904/metal.2022.4444

Abstract

The metallurgy includes the oldest branch of technology and science of the humanity. Connected to this, the evolution of the technical installation, thermal or mechanical, has followed a similar impressing path. The iron and steel metallurgy had a fast evolution during time. The technical processes are in continuous changing, depending on humanity demands. Therefore, a study of this magnitude, embraces many aspects, including the geographic area. The present article limits only to some milestones regarding the evolution of the technologies and installations used for iron and steel manufacturing.

Keywords: Metallurgy, iron, history, central Europe, Roman Empire

1. INTRODUCTION

There are presented in the article some processing technologies of iron ore in Europe, and not only, starting with the proto-metallurgy, using the surface material, before the human communities learned to exploit the underground ore deposits. It is necessary to mantion that the entire equipment was rudimentary, constructed by wood, burned clay or iron and had specific forms, seemingly a cavity. We have in view the primary extractive processes, but also processing methods as puddling, forging or casting. In the context of Central European and Middle East ferrous metallurgy the article presents some particularities and common aspects of each region [1].

Being a big demand for the wapons and tools, there has been an evolution of the iron ore processing instruments that has reflected in materials, shape and techniques. The main objective was to ease people's work and to increase their productivity.

2. LOCATIONS AND MAPS

Central Europe comprised most of the territories of the Holy Roman Empire and those of the two neighboring kingdoms to the east, Poland and Hungary. Hungary and parts of Poland were later part of the Habsburg monarchy, which also significantly shaped the history of Central Europe. Unlike their Western European counterparts, the Central European nations never had any notable overseas colonies due to their inland location and other factors. It has often been argued that one of the contributing causes of both World War I and World War II was Germany's lack of original overseas colonies.

According to Emmanuel de Martonne, in 1927 the Central European countries were: Austria, Czechoslovakia, Germany, Hungary, Poland, Romania and Switzerland. The author uses both human and physical characteristics to define Central Europe [2]. **Figure 1** presents the Central Europe following the evaluation of Emmanuel de Martonne.

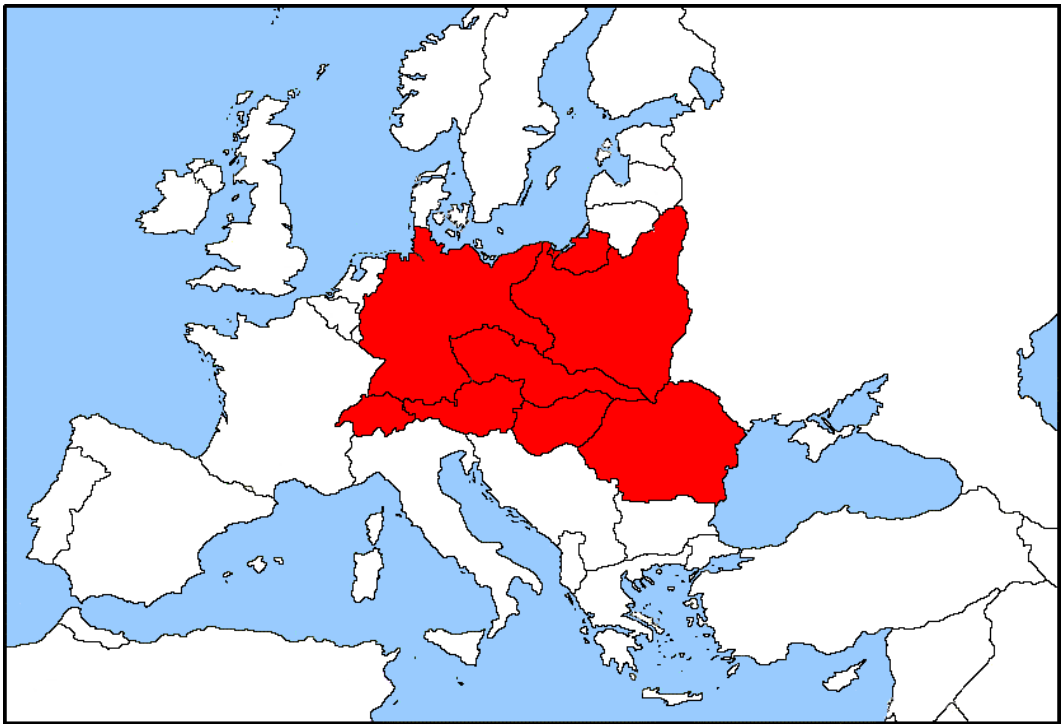

Figure 1 Central Europe according to the geograph E. de Martonne

The Roman Empire is the greatest place for the developement of the culture and the technology during the periode of its existence. **Figure 2** presents the borders of the Roman Empire at the maximum period of its expansion [3].

Figure 2 The limits of the Roman Empire during of its maximum expansion

3. LOCATIONS AND ARTEFACTS ON ROMANIAN TERRITORY

Also, the entire equipment was rudimentary, constructed by wood, burned clay or iron and had specific forms, seemingly a cavity. Later, humanity began to understand the iron ore importance, starting to use iron for many activities. **Figure 3** shows the iron furnace located in the western Romania.

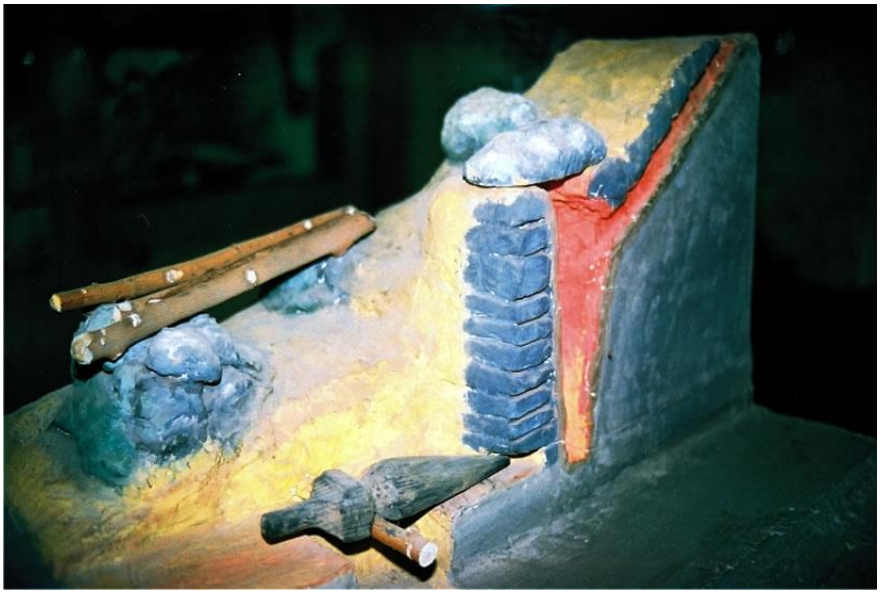

Figure 3 Iron furnace in Ghelar, Romania

Figure 4 presents the location of map of the main smitheries from Hunedoara county [5].

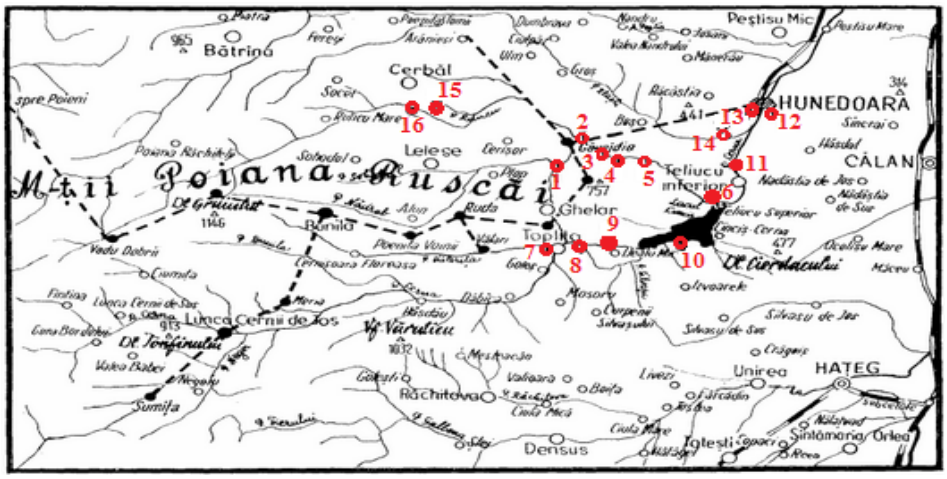

Figure 4 Location of the main smithereens in Hunedoara County, Romania

4. TECHNOLOGICAL PROCESS TO OBTAIN THE IRON FROM IRON ORE

It can be considered that the load and the physic-chemical process were the following [5]:

- on the hearth was put embers then charcoal,
- it loads iron ore and alternating charcoal and limestone,
- lay a layer of fine iron ore then slag,
- the furnace was covered with a layer of fine iron ore.

The chemical reactions are the following:

$$C + O_2 = CO_2;\ H = -384\ kJ/mol$$
$$CO_2 + C = 2CO;\ H = 169\ kJ/mol$$

$$2C + O_2 = 2CO;\ H = -215\ kJ/mol$$

The theoretical combustion temperature would be 1400 ^{0}C and the real one, if you take into account the low efficiency of the furnace is 1350 ^{0}C. The burned gases (CO, CO_2, H_2, N_2) crossed the loaded column, the period during which the CO reduction took place:

$$Fe_3O_4 + CO = 3Fe + CO_2$$
$$FeO + CO = Fe + CO_2$$

Due to the low temperature, and the small ore column, the indirect reductions were almost insignificant. As the height of the furnace increases, the proportion of indirect reductions in all iron oxide reduction reactions has also increased.

5. EXAMPLES FOR THE ANCIENT METALLURGICAL FURNACES

In the next pages there are presented some ancient metallurgical furnaces, discovered in some area corresponding to the period of Roman Empire and Middle Age. In **Figure 5** is depicted a copper pit furnace [6].

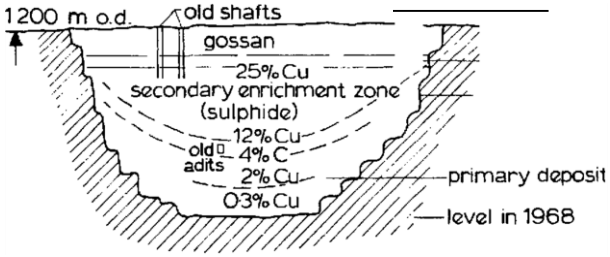

Figure 5 Section through a typical open pit copper mine showing the primary sulphide ore at depth and enrichment below the gossans (Ergani Moden, Turkey)

Another interesting representation for iron production is depicted in **Figure 6.** It was discovered in Huttenberg, Austria [6].

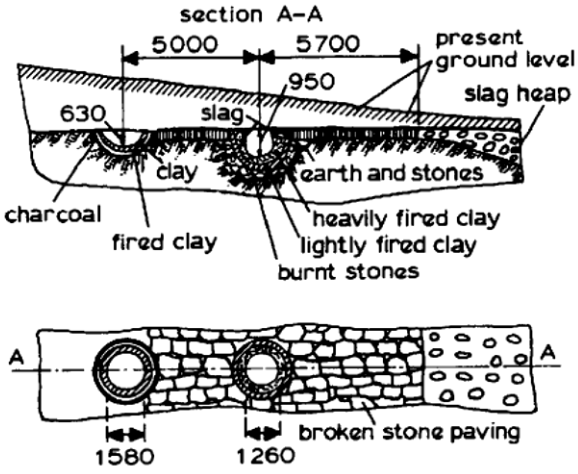

Figure 6 Early Iron Age bowl furnaces from Huttenberg, Austria; dimensions in mm (after Coghlan)

6. THE MIDDLE EAST

Interesting aspects regarding the evolution of the metallurgy it is possible to find in Middle East, where the religious evolution has influenced the evolution of the metallurgy [7]. The area of reference is ancient Judea, where are also interesting artefacts regarding the metallurgy. In **Figure 7** is presented the above mentioned area during the Roman Empire.

Figure 7 Judaea Province during the first century [8]

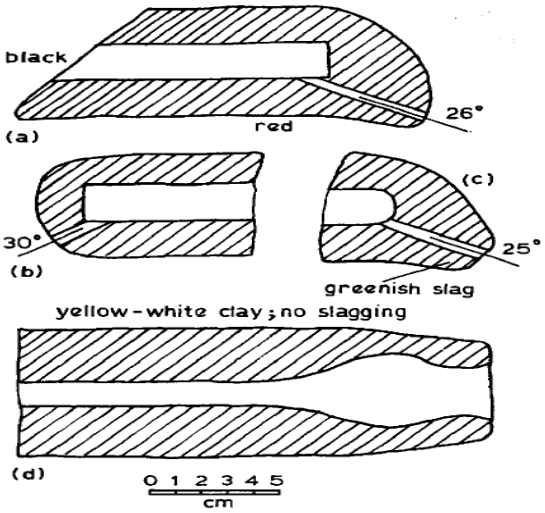

Figure 8 Types of tuyeres found at Tel Zeror, Israel

Canaan was inhabited by peoples who possessed a high level of metallurgical development and creativity. Coming into contact with these peoples, the Jews were able to assimilate new metallurgical technology, the exception being the processing of iron [7]. For example, in **Figure 8** are presented types of tuyeres in Israel.

7. METALLIC COINS – AN ECONOMIC AND HISTORICAL ASPECT OF PALEO – METALLURGY

The history of coins stretches back to the first millennium BC/BCE. Notable examples of early coins include the Lydian coins, Persian coins, and Arabic coins. Later, there are Roman and Greek coins. The metal used was bronze, silver and gold. Coins were first made of scraps of metal by hitting a hammer positioned over an anvil. The Chinese produced primarily cast coinage, and this spread to South-East Asia and Japan. Although few non-Chinese cast coins were produced by governments, it was a common practice amongst counterfeiters. The Lydian Lion coins were made of electrum, a naturally occurring alloy of gold and silver but of variable precious metal value [9]. The royal lion symbol stamped on the coin, similar to a seal, was a declaration of the value of the contents. These directly preceded ancient Greek coinage, through which Rome begot all Western coinage. Indian coinage has largely been a product of Greek, Roman, and Islamic influences.

During the Roman Empire a lot of interesting coins were used. The most moving story of all time, the story of Jesus of Nazareth, has been told in several versions, over and over again. But have you thought about telling it about it with the help of the original coins circulated? In **Figure 9** there are presented some coins in circulation during this period.

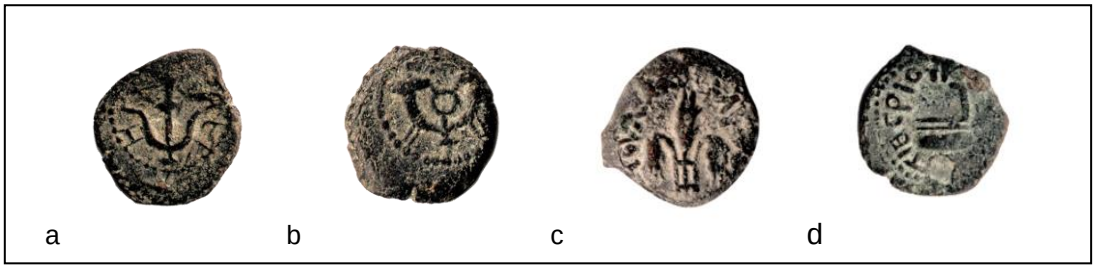

Figure 9 The historical coins, which were minted in Judea and used during the life of Jesus; the first of these (a, b) – the “prutah” of Herod the Great, was beaten during the birth of Jesus during the reign of the king; the second, coin (c,d) – Pontius Pilate's “prutah”, is associated with the crucifixion of Jesus, which was, are also Roman coins

We have also to mention the gold coins from Dacia and the Greek colonies, on the Danube River. In **Figure 10** is the “kosson” (a Dac coin, originally in gold) and in **Figure 11** the Greek coin from the Black Sea colonies.

Figure 10 The Dac coin “kosson”, in gold

Figure 11 Greek coin “iΣτPIH” (istrii)

8. CONCLUSIONS

The present paper is only a short overview of the most important technology in the evolution of the humanity. It started some millenniums ago and is developing more and more today.

The analysis has in view the primary extractive processes, but also processing methods as puddling, forging or casting. In the context of Central European and Middle East ferrous and nonferrous metallurgy the article presents some particularities and common aspects of each region. Certainly, we have to continue the researches in documents, literature as well as on the field using specific method of investigation. We hope to increase the investigation area and methodologies.

ACKNOWLEDGEMENTS

Special acknowledgments to the organization having offered information access regarding the history of the coins and to obtain the collection of thus interesting and useful artifacts.

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